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(54) Inflatable safety restraint for vehicle occupant protection

(57) An inflatable safety restraint arrangement is provided which is particularly helpful to protect vehicle occupants from transverse components of crash forces such as are experienced in side impacts. An inflatable cushion in the deflated state is folded and mounted in a flexible pocket and is fixedly attached to the vehicle at at least two spaced positions. The flexible pocket comprises a line of weakness such as a tear seam along which the pocket opens when subjected to forces generated during inflating of the cushion and through which the inflating cushion deploys to a position between the vehicle occupant and the adjacent vehicle surface (eg door) in the event of a crash situation being detected. The flexible pocket is preferably fabric though it may be of a plastics material and the tear seam comprises a stitched seam the stitches of which either break or unravel when the airbag cushion is deployed. The airbag cushion with or without the appropriate inflator may be mounted either in the vehicle seat or in the roof or in a structural side beam such as the B pillar. In the case of mounting the cushion in the seat it is preferably enclosed within the seat cover so as to follow the contours of the seat and provide a comfortable, unobtrusive fitment. In this case the inflator may be advantageously mounted in a main seat tube. Since separate housings are not required either for the inflator or the airbag cushion, considerable savings in expense and assembly time are made.

The tear seam is preferably aligned with a seam of the seat cover (or the roof lining) so that both seams tear together on deployment of the airbag cushion. This form of flexible pocket tear seam allows for a much more controlled deployment of the bag reducing some of the initial forces which can in themselves cause damage to the occupant, yet at the same time allowing deployment of the bag within the required time frame of 2 to 4 milliseconds.

A manifold for connecting the inflator to the cushion is described in which gas flow is directed onto an inside wall of the manifold so as to retain the manifold in the cushion and seal it. This protects the cushion mounting area from the direct effects of the hot gas from the inflator and allows a mounting angle between the inflator and the cushion of anything between 0 and 180°. The outer manifold surface may be welded or stitched to a manifold mounting area of the cushion.

The airbag cushion itself is preferably an elongate arcuate shape such as a fat banana and the attachment positions are at the tapering ends of the bag. In another embodiment an additional portion of the bag extends away from the two attachment points to provide additional protection for the head of the vehicle occupant.

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an inflatable safety restraint or airbag for protecting an occupant of an automobile in a crash situation particularly from transverse components of crash forces, such as are produced in side or oblique impacts.

[0002] In particular the invention relates to the construction and shape of an inflatable airbag and to an inflator for such an airbag and to means for housing the inflator and the airbag in appropriate positions relative to the automobile occupant and to means for deploying the airbag quickly and for maximum protective effect.

[0003] This application is a divisional application of EP 95 931 300.8 published as 0 777 591 A.

BACKGROUND OF THE INVENTION

[0004] It has been proposed in known systems to protect vehicle occupants during a side impact collision by introducing an airbag between the occupants torso and an interior surface of the vehicle. United States Patent 3,617,073 is illustrative of a system in which an airbag protective system is located within the vehicle door.

[0005] US 5 322 322 illustrates the use of an airbag in the vehicle trim above the window and describes the bag being located in a flexible pocket.

[0006] British Patent 2 232 936 B shows an airbag mounted in a vehicle seat.

[0007] With regard to seat mounted airbag systems it is desirable for the airbag and its associated mounting hardware to be constructed in a way that it is compatible with seat design and does not interfere with occupant comfort. All known airbag technologies mount the airbag in a rigid cover. This type of construction if placed behind the soft, compliant foam padding (or seat cover) of the seat reduces the resiliency of the padding lessening occupant comfort.

[0008] Inflators for airbags are necessarily bulky and heavy items since they contain compressed gas for inflation which must be safely contained. Traditionally an inflator comprises a cylindrical steel container which is mounted in a metal housing into which the airbag is folded. The resultant package which must be fitted into an automobile is bulky and unsightly and problems have been encountered in mounting such packages in the optimum positions within an automobile for safety purposes while satisfactorily disguising them to the satisfaction of interior designers, particularly in arrangements for protection against side impact forces.

[0009] According to the present invention there is provided an inflatable safety restraint system for protection of a vehicle occupant from transverse components of crash forces, the arrangement comprising an inflatable cushion (8) which in the deflated state is folded and mounted in a flexible pocket (5), the cushion (8) having attachment means (13) for attaching it to vehicle seats (15) at least two positions spaced one from the other by a distance less than the length of the inflated cushion (8), the inflated cushion (18) assuming a shape which arches away from a straight line joining the attachment points, the flexible pocket (5) being contained within a cover (3) of the vehicle seat (15) so as to follow the contours of the seat (15) and comprising a line of weakness (6) along which the pocket (5) opens when subjected to forces generated during inflation of the cushion (8) and through which line of weakness (6) the inflating cushion (8) deploys, the pocket (5) being mounted in the vehicle such that the cushion (8) deploys to a position between the vehicle occupant and an adjacent internal vehicle surface in the event of a crash situation being detected, wherein one of the attachment points (13) is arranged to be above an occupant's shoulder, and the cushion (8) is folded to a length substantially smaller than the height of the back of the seat (15).

[0010] The flexible pocket is preferably of fabric material, eg a woven medium, and the line of weakness comprises a stitched seam which may be adapted to open by tearing along the stitching on deployment of the cushion or alternatively by unravelling the stitching.

[0011] Alternatively a flexible plastics material may be used for the pocket and for example formed by folding a single piece of plastics material and securing that open edge (through which the airbag cushion is to be deployed) by glue, crimping or rivets such as plastic so-called "Christmas Tree" fasteners, to form the line of weakness through which the cushion will deploy.

[0012] According to a preferred embodiment of the present invention the flexible pocket is mounted in a vehicle seat, preferably within a cover of the seat in such a way as to follow the contours of the seat. Preferably one of the attachment positions of the cushion to the vehicle is in line with or above the shoulder of the vehicle occupant.

[0013] The line of weakness may advantageously be aligned with a seam of the seat cover, or with an otherwise relatively weaker part of the cover, so that the inflating cushion deploys through the line of weakness and thus through a predetermined location on the seat such as the seam of the seat cover. The line of weakness in the pocket and the seam in the cover may in fact be one and the same, eg the same stitching forming seams in the pocket and the cover, or the seat cover being constructed so as to form the pocket itself. The pocket and the seat cover need not be positively connected but if they are then preferably the pocket is sewn to the seat cover with a seam which is stronger than the tear seams in either the pocket or the cover.

[0014] The opening of such a seam is controlled since the thread, typically 100-500 Newton of tear strength, is designed to be the weakest point of the system, whereas in existing technologies the cushion hits the seat cover during deployment somewhat like a fist and breaks the cover material or the thread in an uncon-

trolled manner, and then parts of the seat cover material can be ejected towards the occupant.

[0015] Preferably the arrangement of this preferred embodiment further comprises an inflator mounted directly to a part of a seat frame for example by mounting in a seat frame tube such that the seat tube provides a housing for the inflator. Preferably the main seat tube is used, i.e. that running generally horizontally in the lower backrest of a seat, in the area corresponding generally to the "small" of an occupant's back. This is particularly useful for an inflator of the type which is known generally as a 25 mm hybrid inflator since this can fit easily into such a seat frame tube. The inflator may be slotted into the tube or screwed in with appropriate cooperating threads being provided in the seat frame and the inflator container or alternatively bolted or screwed to rigid parts of the seat frame.

[0016] The necessary wiring to the crash sensor and inflator actuator is thus also advantageously protected by the seat tube.

[0017] This arrangement provides advantages in that the number of components is reduced over prior art systems because a separate inflator housing is unnecessary since the seat frame provides sufficient support and strength. There are attendant cost savings, and advantages in versatility since the airbag or inflatable cushion can easily and accurately be positioned in alternative locations to optimise safety.

[0018] Furthermore it has been determined that the delta v of the occupant's ribs due to accidental inflation induced injuries are much lower than with compressed folded traditional side impact airbags, since with the invention the line of weakness (such as the tear seam) provides for controlled opening of the seam which opens like a zip, and also because the arrangement allows the cushion to be prefolded along a larger section of the side of the seat than with known systems. Hence the initial acceleration of the cushion is reduced and the arrangement of the inventon is safer for the occupant than conventional arrangements with rigid housings.

[0019] The two attachment points for the cushion allow accurate positioning of the cushion for the desired relative amounts of head and thorax protection of the occupant to be achieved and offer the possibility of protecting a larger area of the vehicle occupant with a relatively smaller cushion. For example, it makes it easier to customise the cushion position to the unique geometry of a particular automobile, the particular requirements of safety regulatory bodies in different countries and the different average sizes and dimensions of automobile occupants in different countries.

[0020] Preferably the arrangement is such that the finished module is of a length which is smaller than the height of the back of the seat, thereby permitting the module to be mounted at any one of many locations within the seat back without distracting from occupant comfort or requiring the seat manufacturer to alter his specifications.

[0021] The invention provides for a compact lightweight arrangement which does not protrude from the contours of the mounting area (eg the seat) and is therefore comfortable, and visually acceptable to the occupant.

[0022] The inflatable cushion may take many forms and shapes. A particularly advantageous shape is an elongate arcuate shape, such as a fat sausage or banana shape with the two attachment points at opposite ends. The cushion is preferably premoulded in this shape with a fat central portion and tapering end regions.

[0023] A single manifold, for connection to an inflator, is preferably provided at one end of the cushion, for example in combination with one of the attachment points.

[0024] It has been found by the inventor that such an arcuate elongate shape encourages a fixed direction of inflation on deployment of the airbag whereas traditional airbags require a rigid housing not only to hold the uninflated airbag but to encourage the optimum direction of inflation. Additionally, this shape of the cushion provides the possibility, not only of stabilising the harder parts of the body such as the shoulder and pelvis areas, but also gives a soft buffer for the softer abdomen area, and for the head.

[0025] Even more preferably the airbag cushion comprises a first portion extending between the two attachment points for torso protection and a further portion extending away from one of the attachment points for protection of an occupant's head.

[0026] In another preferred embodiment of the invention one or more rip cords are sewn or otherwise secured to the cushion, preferably at a region of the cushion which is furthest from the attachment points on inflation, and the other end of the rip cord is secured to one end of the line of weakness or seam so as to facilitate tearing of the seam. The rip cord could also be connected to the yarn of the tear seam so that when the cushion is deployed, the yarn is pulled and unravelled thus opening the tear seam in an unzipping action.

[0027] This has the advantage that the cushion is inflated through a predetermined location on the seat without the need for expensive housing arrangements.

[0028] According to an advantageous embodiment of the present invention the arrangement is provided with an inflator mechanism and an inflator manifold, wherein the inflator mechanism has an output for inflation gas constructed and arranged to direct gas flow onto an inside wall of the manifold so as to retain the manifold in the cushion.

[0029] This arrangement has the added advantage of protecting the cushion mounting area from the direct effects of the hot gas flow from the inflator. Also, the inflator and the cushion can be mounted at an angle of anything between between 0 and 180° to each other allowing for versatility in mounting the inflator and the

cushion in awkward locations.

[0030] The manifold opening in the cushion may be an open slit seam of a width approximately equal to half the outside circumference of the inflator manifold so as to fit snugly round the manifold.

[0031] The manifold may comprise a plastics material and preferably a polyvinylchloride (PVC) material or alternatively a nylon material.

[0032] In this embodiment the outer manifold surface may be welded to a manifold mounting area of the cushion to form a preferably continuous welded seal between the airbag and the manifold. Such a welded seal may be formed by ultrasonic radiation whereby heat stakes are positioned at spaced intervals in a region around the gas inlet of the cushion on the outer manifold surface to effect the required bond between the plastics manifold and the cushion fabric. However stitching may be used.

[0033] Such a manifold fixing means is applicable to any form or shape of cushion and may be used for other than side impact airbag arrangements.

[0034] The shape of the pocket is chosen to provide the optimum tear direction. The pocket is thus preferably tapered cowards one end and arranged in conjunction with the cushion and the inflator so that it starts to open at the widest portion. The pocket may be mounted in a seat either with the wider portion at the lower part or at the higher part and the tear direction corresponds accordingly.

[0035] For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS.

[0036]

Figure 1 is a partial sectional view of an automobile seat illustrating an inflatable safety restraint arrangement according to one embodiment of the invention.

Figures 2a and 2b are partial sectional views of the seat of Figure 1 arranged for vertical inflator attachment, in side elevational and in perspective view respectively.

Figure 3 illustrates an exploded view of the seat of Figure 1.

Figure 4 illustrates a deployed inflated airbag cushion attached to a seat.

Figure 5 illustrates a deployment sequence for an airbag arrangement according to an embodiment of the present invention.

Figure 5a illustrates an alternative mounting position on the seat for an airbag arrangement according to the invention.

Figure 6a is a cross-sectional view and Figure 6b a cut away perspective view of the side of a seat illustrating an embodiment of the invention with the airbag cushion mounted in the seat.

Figure 7 is a detailed illustration in cross-section of part of a seat embodying an airbag arrangement according to the present invention.

Figures 8, 9, 9a, 9b and 9c illustrate different shares for an airbag cushion according to embodiments of the invention.

Figure 9d is an exploded perspective view of an airbag cushion of the shape shown in Figure 9c.

Figures 10, 11 and 11a show alternative pockets for airbag arrangements according to the invention.

Figures 12, 13 and 14 each show a cross-sectional view or a respective preferred embodiment of a manifold fixing means for use with the invention, and Figures 19a, 20a and 21a show plan views along arrow A of Figures 19, 20 and 21 respectively.

Figures 15 and 16 show a manifold opening for an airbag arrangement for use with the invention before and after assembly of the manifold.

Figure 17 shows an alternative manifold opening.

Figure 18 is a cross-sectional view of the manifold and airbag opening of Figure 17

Figure 19 is a cross-sectional view of an alternative arrangement showing connections of inflator, manifold and airbag cushion.

DETAILED DESCRIPTION OF DRAWINGS.

[0037] Figure 1 illustrates a partial sectional view of an automotive seat, showing one possible location of a seat cover integrated side impact airbag module. Shown herein is part of a seat 15 with a seat cover 3 having an airbag cushion 8 integrated in a seat cover pocket 5. This seat cover pocket 5 is made of a flexible fabric highly resistant to tearing. The folded airbag cushion 8 extends out of the cover at one end and is attached to the substructure 2 of the seat 15 by bolts or rivets through the attachment mounting holes 13. At the other side the manifold 4 projects into the cushion through the pocket 5 and makes the lower attachment to the seat frame 2 and to an inflator 1.

[0038] The flexible pocket 5 is made of fabric and

stitched to form a tube enclosing at least the central section of the airbag cushion 8. A tear seam 6 is provided in the pocket offering a line of relative weakness through which the cushion will deploy on inflation.

[0039] Figures 2a and 2b show an arrangement whereby the inflator 1 is arranged vertically within the seat structure. Here the manifold 4 is at the upper end of the airbag cushion 8 and the attachment mounting holes 13 at the lower end. The pocket 5 completely surrounds the airbag cushion 8.

[0040] Figure 3 illustrates an assembly of panels to make cushion 8 and the manifold 4 inside the seat cover integrated pocket 5 and the inflator 1 and their positions relative to the seat 15. The manifold 4 is sewn inside the panels of cushion 8 with cushion reinforcements 14 in the mounting area. The manifold 4 extends through the cushion reinforcement 14 and the pocket manifold opening 16 in order to create a clamping area to the seat frame 2 and seal the complete cushion assembly. The cushion reinforcement 14 is typically of heat resistant fabric. The inflator 1 is threaded or clamped to the manifold 4. The pocket 5 is sewn to the seat cover 3 with a very strong sew line to provide a tear seam which connects the two panels of pocket 5 together with a predefined tear seam strength, preferably between 100-500 Newton. The tear seam thread and/or stitch pattern is chosen accordingly.

[0041] The inflator 1 is screwed or bolted to the seat frame tube 17 as shown and an initiator 18, shown in the form of wires, extends from an impact sensor which may be of known construction (not shown) and the inflator 1.

[0042] In Figure 4 the cushion 8 is shown in the inflated state relative to the seat 15. The cushion shape is arranged to cover the area from a 5th female dummy lower rib up to the upper rib of a 95th male dummy. This is typically 3-400 mm. The thickness of the cushion is between 50 and 200 mm. The third dimension, towards the steering wheel, is between 200 and 400 mm starting with the outer contour of the seat. The cushion shape at the seat area is designed to cover the outer seat foam contour in order to maximise the volume of the cushion outside of the seat contour.

[0043] Figure 5 shows various stages of airbag inflation by illustrating the seat and seat cover integrated airbag in a series comprising four adjacent seats. This is of course a single seat but is shown in four different stages of airbag inflation. Positioned in the out board side 11 of the seat cover 3 is an airbag cushion 8 secured to an internal part of the seat. The inflator may be directly mounted to the seat frame by the manifold 4 and is connected to the cushion 8 via this manifold 4. The inflator 1 may be a hybrid inflator of the type which releases heated inflation gas into the airbag or an inflator that uses a solid propellant such as sodium azide, or another type of inflator. Prior to activation of the inflator 1 the airbag cushion 8 is maintained in a simple folded condition within the pocket 5 inside the seat cover 3 on the outboard side 11 of the seat 15. Subsequent to sensing an impact with the side of the vehicle (by using an impact sensor of known variety) the inflator 1 is activated thereby releasing or generating inflation gas which fills the airbag cushion 8. The airbag cushion will start to be filled inside the seat cover 3. Due to the construction of the seat cover integrated pocket 5 the initial forces will be directed to the tear seam 6. The tear seam thread is the weakest point in the complete pocket area and will be torn in a very controlled way. As the bag inflates it becomes positioned generally between the side of the occupant's thorax (and, in some embodiments, the head) and the side door or door panel 12 of the vehicle.

[0044] Figure 5b illustrates an embodiment where the airbag cushion 8 is mounted in the base part of the seat. The cushion 8 is shown schematically in an inflated state. The inflator 1 is housed in seat frame tube 17 and connected to the cushion 8 by manifold 4. The other end of the cushion 8 is bolted to a structural part of the seat base by cushion attachment holes 13.

[0045] Figure 6 shows the tear seam concept in detail. The airbag cushion 8 is folded inside the pocket 5 within the seat cover 3 and adjacent the foam 9 of the seat. The tear seam 6 is so constructed that all other parts of the pocket 5 are stronger in tear strength. This is done using a stronger thread for the other sides than for the tear seam 6. As the bag inflates the cushion 8 will be filled inside the pocket first. The outer side walls of the pocket (made out of strong fabric material) will lead the inflation forces directly to the tear seam (which is the weakest point in the closed system) and will tear the tear seam threads 6. Hereafter the filling air will inflate the cushion further and open the complete seat cover like a "zip". Once the pocket is opened and the cushion fully inflated then the cushion is positioned generally between the occupant and the vehicle door.

[0046] Figure 6b shows a part cut away view of a seat with airbag cushion 8 mounted within seat cover 3 adjacent seat foam 9 and attached to a part of the seat frame 2 by snap on pins 21 such as plastic "Christmas tree" poppers. The pins 21 are not shown to scale and fit through attachment holes 13.

[0047] In Figure 7 the airbag cushion 8 is folded within pocket 5 in seat foam 9 and enclosed by the seat cover 3. Here the tear seam 6 of pocket 5 is attached to the seam 23 of the seat cover 3. Either or both seams may be formed of a chain stitch so that a pull on one side causes the stitch to unravel and open the seam. Alternatively the seam stiches may tear. Typically the type of stitches and/or the strength of thread is chosen to make a tear seam having only 40% of the strength of the fabric.

[0048] Alternatively or additionally one or more rip cords 22 may be used to attach the cushion 8 to a part of the seam or seams so as to aid the process of tearing the stitches as the cushion inflates. Such a rip cord may, for example, be sewn to an outermost point of the cush-

ion (considered in its inflated form) and to the start of the tear seam. Thus, before deployment the cord or cords are relatively closely connected to the tear seam. During deployment the cord pulls on the edges of the seat cover material to tear the seam, or alternatively pulls the thread of the seam directly. The tear seam is required to open within 2 to 4 milliseconds to fulfull standard safety requirements.

[0049] This arrangement for the tear seam provides an inexpensive and light way of accurately controlling the deployment of a safety cushion.

[0050] There are many shapes contemplated by this invention for the airbag cushion and these are conveniently preshaped in a way which assists the cushion to inflate in a predetermined direction during deployment. The shapes can be made by cutting and sewing suitable airbag fabric, for example in the way which can be seen in the exploded view of Figure 3.

[0051] Figure 8 shows one suitable shape. This is an arcuate sausage shape having attachment points for securement to a seat, at each end. At one end the inflation inlet 23 is provided for connection to a manifold and inflator. At the other end cushion attachment holes 13 are provided.

[0052] Figure 9 shows another suitable shape. Here the cushion is fatter at one end but nonetheless has an arcuate elongate form with two attachment points (one is not known in the Figure as it is hidden).

[0053] Figure 9a is a head and shoulder concept cushion of a squarer form. The two spaced attachment points to the seat 15 are shown at 23 (inflation inlet) and 13 (attachment holes). The inflator is not shown here but may be mounted horizontally or vertically (or indeed any orientation).

[0054] The cushion 8 is shown inflated relative to the position of an occupant thorax 24 and the heads 25, 26, 27 respectively of 5th, 50th and 95th percentile dummies (as defined in standard safety restraint test regulations).

[0055] The size of the cushion shown in Figure 9a is typically 350 mm high and 410 mm wide though a variety of sizes would suit equally well and the dimensions would in practice be tailored to the individual automobile manufacturer's requirements.

[0056] The cushion in Figure 9b is higher than that in Figure 9a and in side view has a forward facing recess 28 at approximately shoulder level of the occupant. A suitable height of this bag would be around 525 mm and this provides secure side protection for not only the thorax 24 of the occupant but also the head, or at least the centre of gravity (25',26',27') of the 5th, 50th and 95th percentile test dummy as shown.

[0057] Figure 9c shows another shape of cushion in plan view. This has a more curved outline than the cushion of Figure 9b and has a generally arcuate portion for thorax protection, falling generally between the two attachment points 13 and 23, and an extension 28 for head protection. Typical dimensions of this type of cushion would be to have an overall height of 700-750 mm, a width of 480 to 520 mm and a distance between attachments 13 and 23 of around 500-530 mm.

[0058] Figure 9d illustrates the cushion of Figure 9c in exploded form whence it can be seen that it is formed of two cushion panels 29 sewn at their edges. The attachment points 13 are shown mounted by bolts or rivets to the structural frame 2 of the seat. The manifold 4 is mounted to the inflation inlet 23 and to the seat frame 2. The inflator 1 is mounted in the seat frame tube 17 and held by a screw or bolt and connected to initiator 18.

[0059] In Figures 10 and 11 two different shapes for pocket 5 are shown. The pocket 5 only partly encloses the folded cushion 8; the attachment parts 13 and 23 extend beyond the pocket. In each case the tear seam 6 will open from the end of the pocket which is widest toward the narrower end. This is shown by arrows 30 and 31 respectively. The pocket can be made of a woven fabric material or of a flexible plastics material. Preferably it is formed from a nylon fabric. As mentioned previously, the pocket 5 may be sewn directly to the seat cover 3 with a stronger yarn or thread than is used for the tear seam. Thus the location of tearing and of deployment of the airbag cushion is effectively predefined and the cushion will deploy within the required time frame of 2-4 milliseconds.

[0060] Such a tear seam provides a very inexpensive, light and controlled way of determining the deployment position and direction of an airbag cushion and the arrangement is easy to assemble and presents no substantial problems during seat assembly.

[0061] Figure 11 a shows a plastic pocket 5, partially enclosing a folded airbag cushion 8. The edge 45 which forms the line of weakness of the pocket 5 is joined by plastic studs 46 such as the known arrow headed versions or "Christmas tree" studs. In this case there is no direct connection between the pocket seam and the seat cover seam.

[0062] Figure 12a illustrates the attachment of manifold 4 to airbag cushion 8 in cross-sectional side view whereas Figure 12b illustrates a plan view of the manifold 4 looking in the direction A in Figure 12a. The manifold 4 is made of a plastics material such as polyvinylchloride (PVC) or nylon and has a radially extending flange 41. The fabric of airbag cushion 8 is also a plastics material such as PVC or nylon and the airbag cushion is welded to radial flange 41 of the manifold by ultrasonic welding between a plurality of heat stakes 42 arranged at spaced points (as shown in Figure 12b around the flange and the airbag cushion fabric.

[0063] In Figures 13a and 13b again the manifold or at least the flange area 43 and the airbag cushion 8 is formed from plastics material such as PVC or nylon. Here however a continuous seal 44 is formed between the manifold and the airbag by a continuous weld around the circumference of the radial flange 41.

[0064] In Figures 14a and 14b the connection

between the radial flange 41 and the airbag 8 is made by a double line 45 of sewing. Again both materials are PVC or nylon. Of course a single line of stitching could be used.

[0065] Figure 15 illustrates a split stitched seam manifold opening for the cushion 8. The manifold opening has a length L equal to half the circumference of the manifold to be used. It is formed by lines of stitching as shown and is found generally in the side of the end of the cushion 8 allowing the inflator to be mounted as 90° to the elongate direction of the cushion.

[0066] Figure 16 illustrates the manifold 4 as sewn in to the cushion manifold opening.

[0067] In Figure 17 the manifold is shown in more detail with an O-ring 47 providing further support for the manifold.

[0068] Figure 18 illustrates how the manifold cushion and inflator may be connected together. The inflator 1 is bolted to the seat structure for example the seat back tube 17 by means of bolt 48. Alternatively it may of course be attached to the vehicle side beam or the structural part of the roof for the embodiments in which the cushion is mounted in other parts of the vehicle. The manifold 4 surrounds the top portion of the inflator 1 and is attached to cushion 8 with further reinforcement being given by a plastic rib 49 which is sewn or inserted into the cushion inflation inlet opening. The manifold 4 is itself attached to a side part 50 of the structure of the seat which is covered by foam 9.

[0069] The inflator may be bolted to the manifold or attached by a nut or it may be attached by a quick connection device such as a snap ring, i.e. an open piston ring which stretches to seal between the inflator and the manifold. The advantage of a quick connection fastening is that it allows the inflator to be inserted as a last operation in the assembly of the safety restraint system. This is of course important from a safety angle.

[0070] In Figure 19 the inflator 1 is shown screwed by screw threading 51 into the manifold. An O-ring 47 is shown to strengthen the inflation inlet of cushion 8. The pulling force of the cushion load direction 52 tends in this case to aid sealing of the manifold.

[0071] It will be clear that many other specific embodiments are possible within the scope of the invention as defined by the claims. In particular many combinations of the preferred features are envisaged.

Claims

1. An inflatable safety restraint system for protection of a vehicle occupant from transverse components of crash forces, the arrangement comprising an inflatable cushion (8) which in the deflated state is folded and mounted in a flexible pocket (5), the cushion(8) having attachment means (13) for attaching it to vehicle seats (15) at least two positions spaced one from the other by a distance less than the length of the inflated cushion (8), the inflated cushion (18) assuming a shape which arches away from a straight line joining the attachment points, the flexible pocket (5) being contained within a cover (3) of the vehicle seat (15) so as to follow the contours of the seat (15) and comprising a line of weakness (6) along which the pocket (5) opens when subjected to forces generated during inflation of the cushion (8) and through which line of weakness (6) the inflating cushion (8) deploys, the pocket (5) being mounted in the vehicle such that the cushion (8) deploys to a position between the vehicle occupant and an adjacent internal vehicle surface in the event of a crash situation being detected, wherein one of the attachment points (13) is arranged to be above an occupant's shoulder, and the cushion (8) is folded to a length substantially smaller than the height of the back of the seat (15).

2. An inflatable safety restraint system according to claim 1 wherein the flexible pocket (5) is formed of fabric material and the line of weakness (6) comprises a stitched seam adapted to open by tearing the stitching on deployment of the cushion (8).

3. An inflatable safety restraint system according to claim 1 wherein the flexible pocket (5) is formed of a flexible plastics material and said line of weakness (6) comprises the line along which opposing surfaces of the pocket are connected with rivets (46) adapted to burst on deployment of the cushion (5).

4. An inflatable safety restraint system according to any preceding claim wherein said cushion comprises a manifold (4) at one attachment point (13) for attachment to a gas generator for inflation thereof, wherein said manifold (4) is at one end of the cushion.

5. An inflatable safety restraint system according to any preceding claim for connecting the inflator to the cushion comprising an inflator manifold (4), wherein the inflator (1) has an output for inflation gas which is constructed and arranged to direct gas flow onto an inside wall of the manifold (4) so as to retain the manifold in the cushion.

6. An inflatable safety restraint system according to claim 5 wherein the inflator (1) is mounted approximately perpendicular to the direction of inflation of the cushion (8).

7. An inflatable safety restraint system according to claim 5 or 6 wherein the cushion (8) comprises an opening for receiving the manifold (4) which opening comprises a slit-seam of a length equal approximately to half the outside circumference of the

manifold (4) so as to fit closely around the manifold (4).

8. An inflatable safety restraint system according to claim 21 wherein the manifold (4) has an outer surface which is attached to a manifold mounting area of the cushion (8) by a welded join, forming a continuous unbroken seal around the manifold opening.

9. An inflatable safety restraint system according to any one of claims 1 to 7 wherein the manifold has an outer surface which is attached to a manifold mounting area of the cushion by stitching.

10. An inflatable safety restraint system according to any preceding claim wherein the flexible pocket has an elongate form tapering in the long direction and is arranged and adapted to open along the line of weakness starting at its widest part.

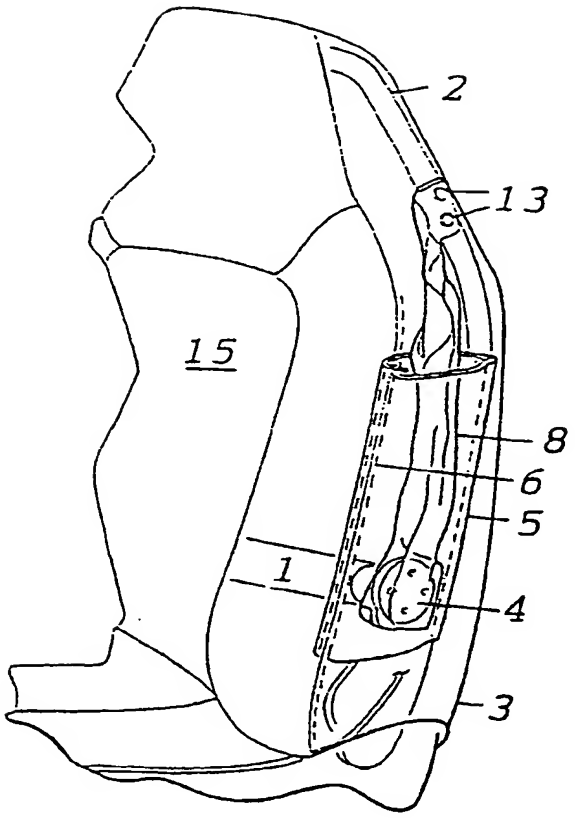

FIG. 1

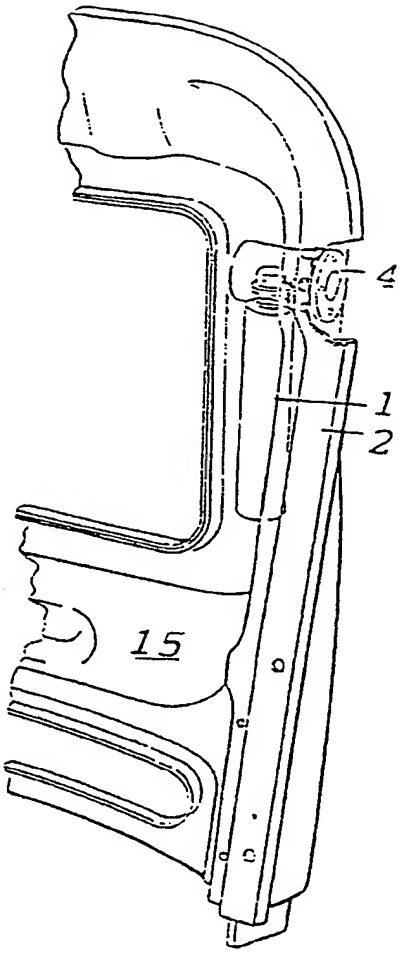

FIG. 2b

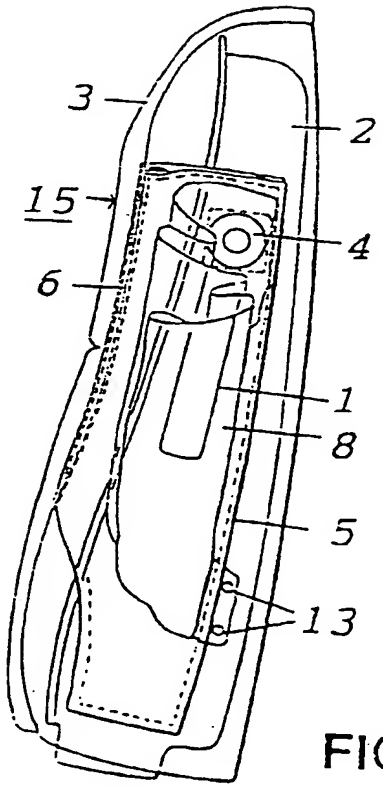

FIG. 2a

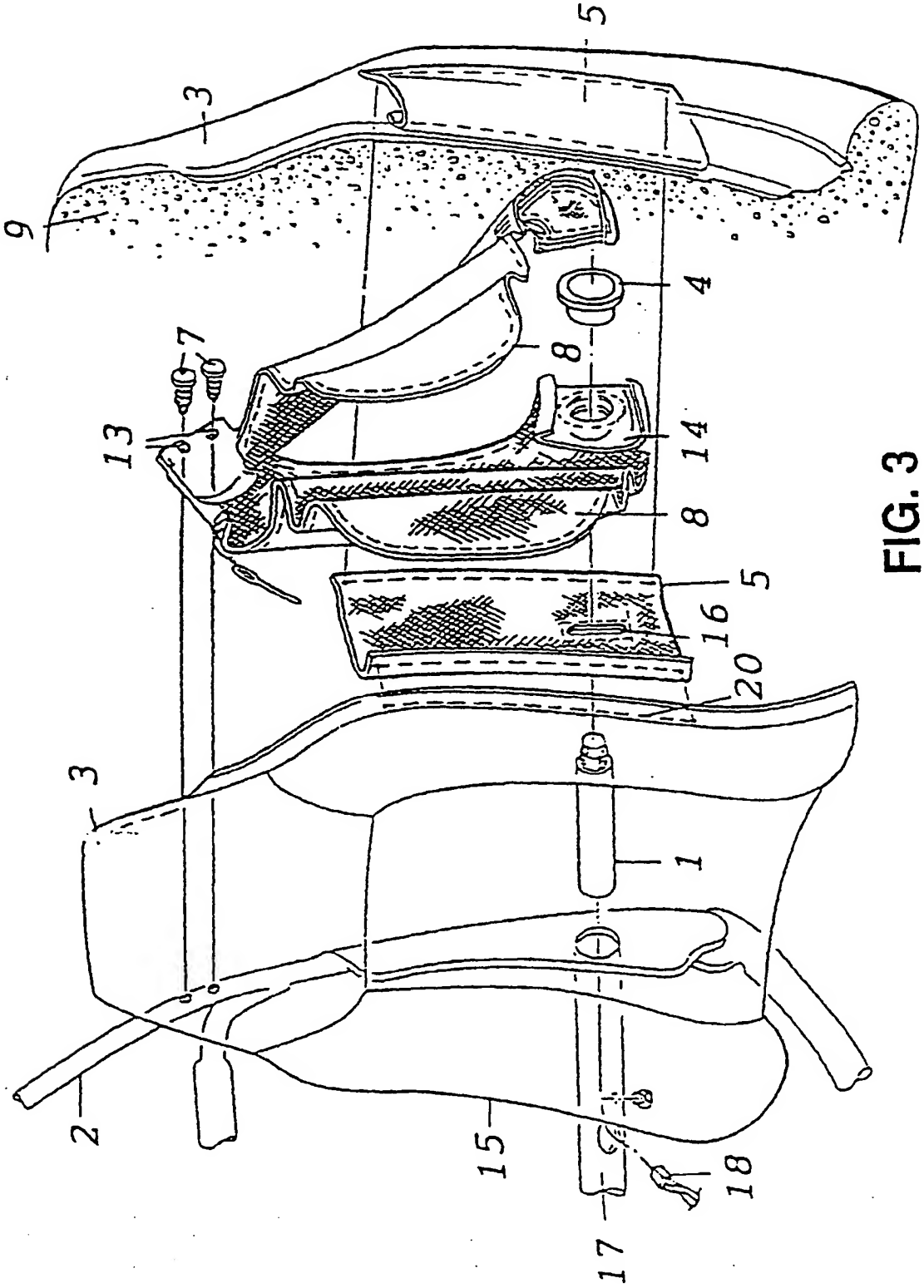

FIG. 3

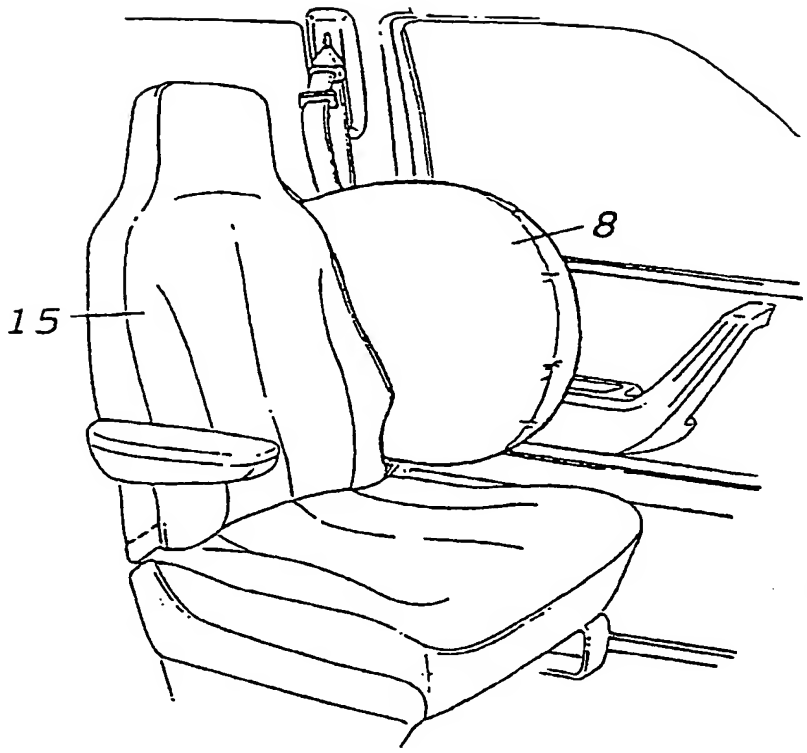

FIG. 4

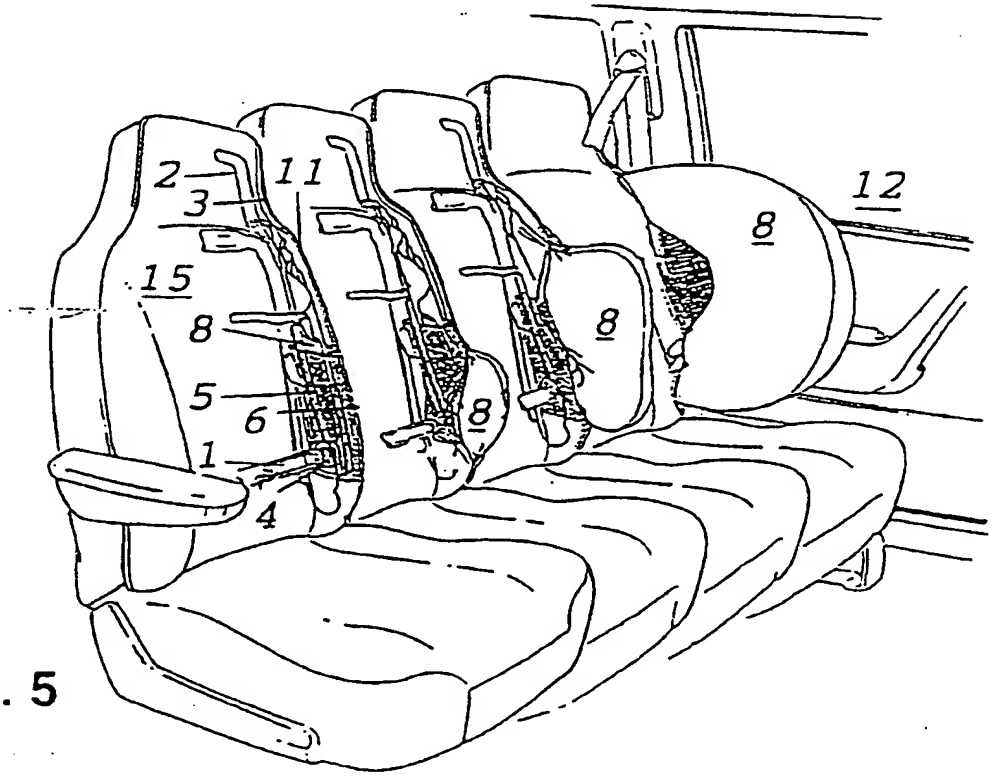

FIG. 5

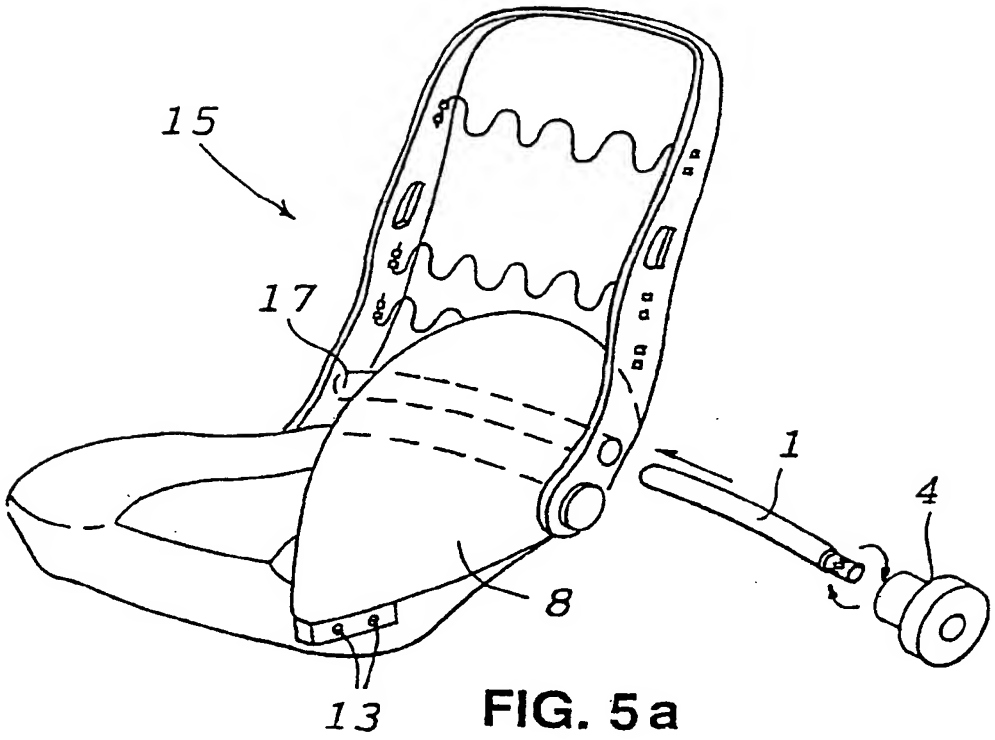

FIG. 5a

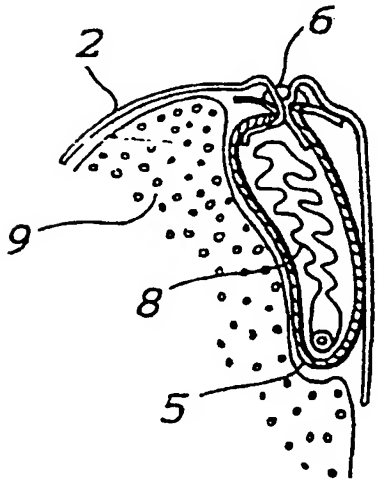

FIG. 6a

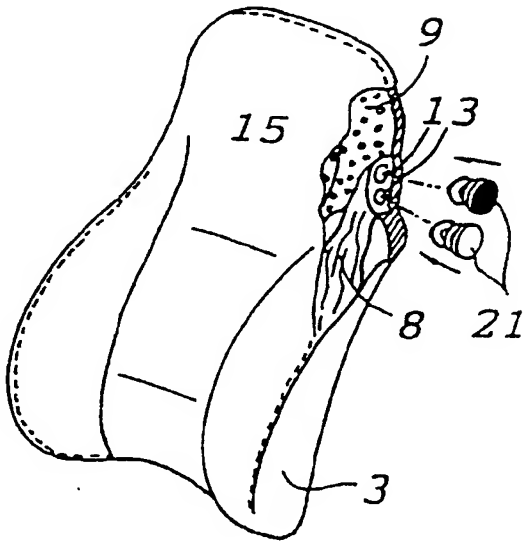

FIG. 6b

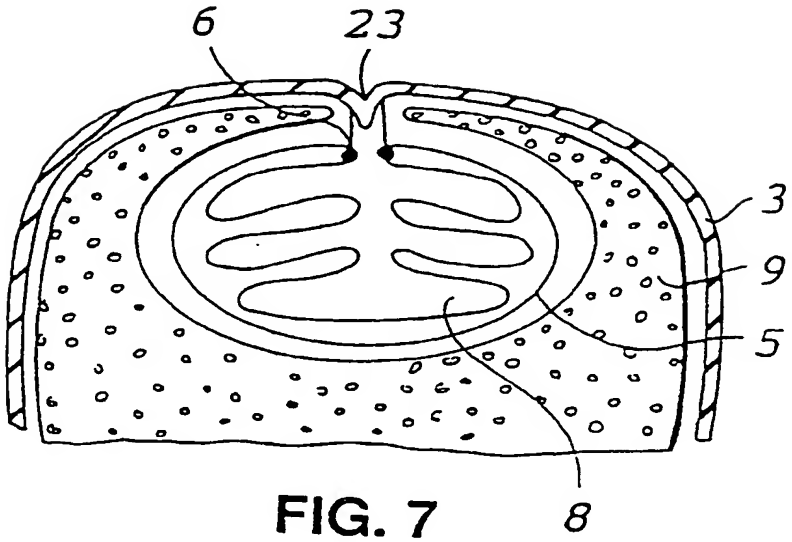

FIG. 7

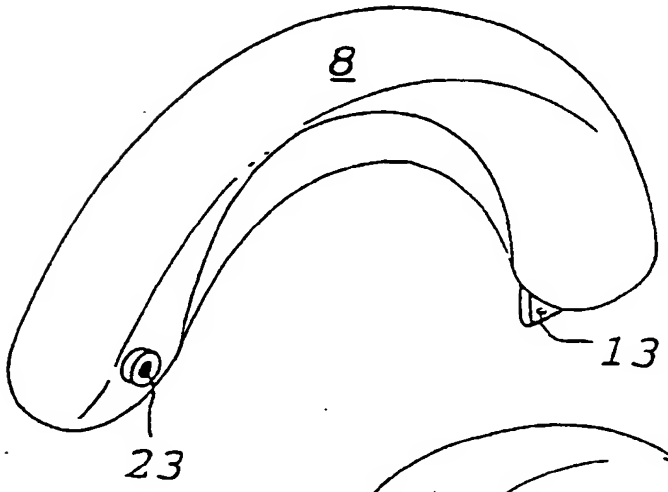

FIG. 8

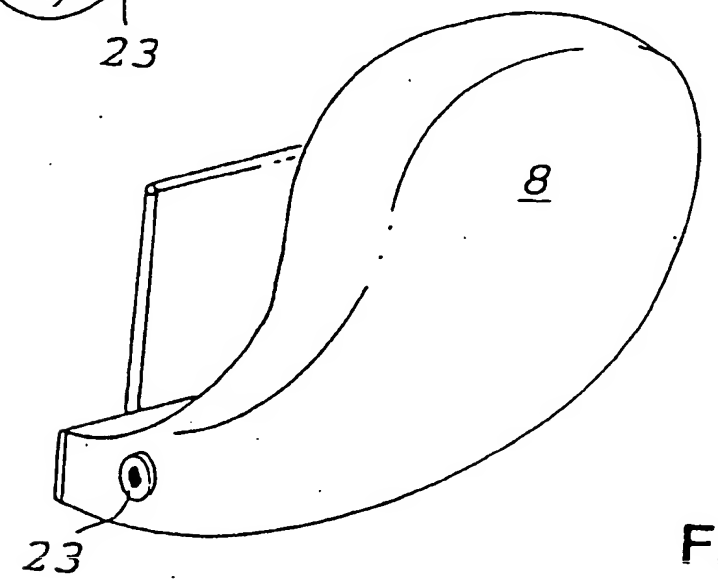

FIG. 9

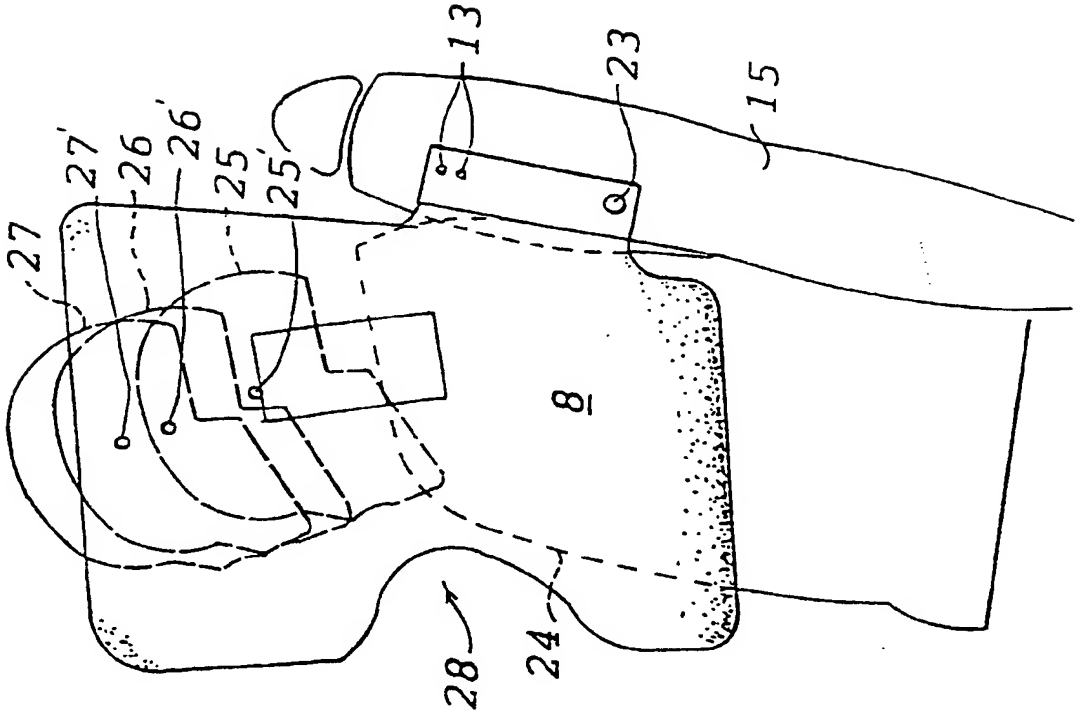

FIG. 9b

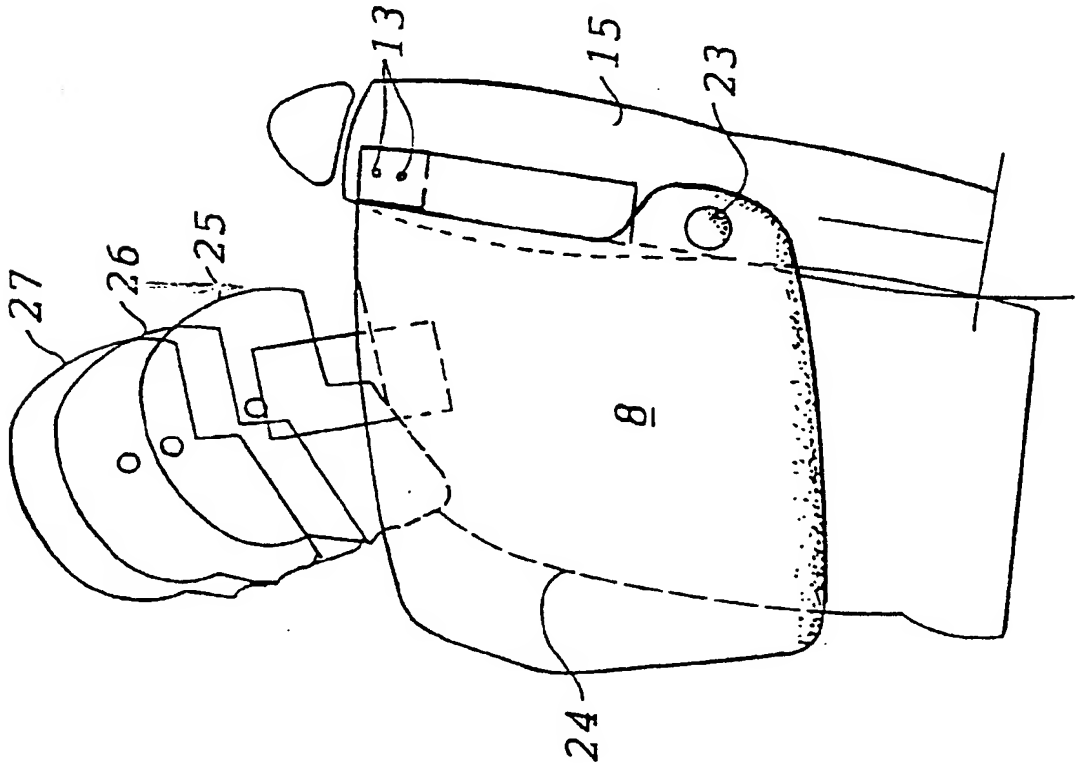

FIG. 9a

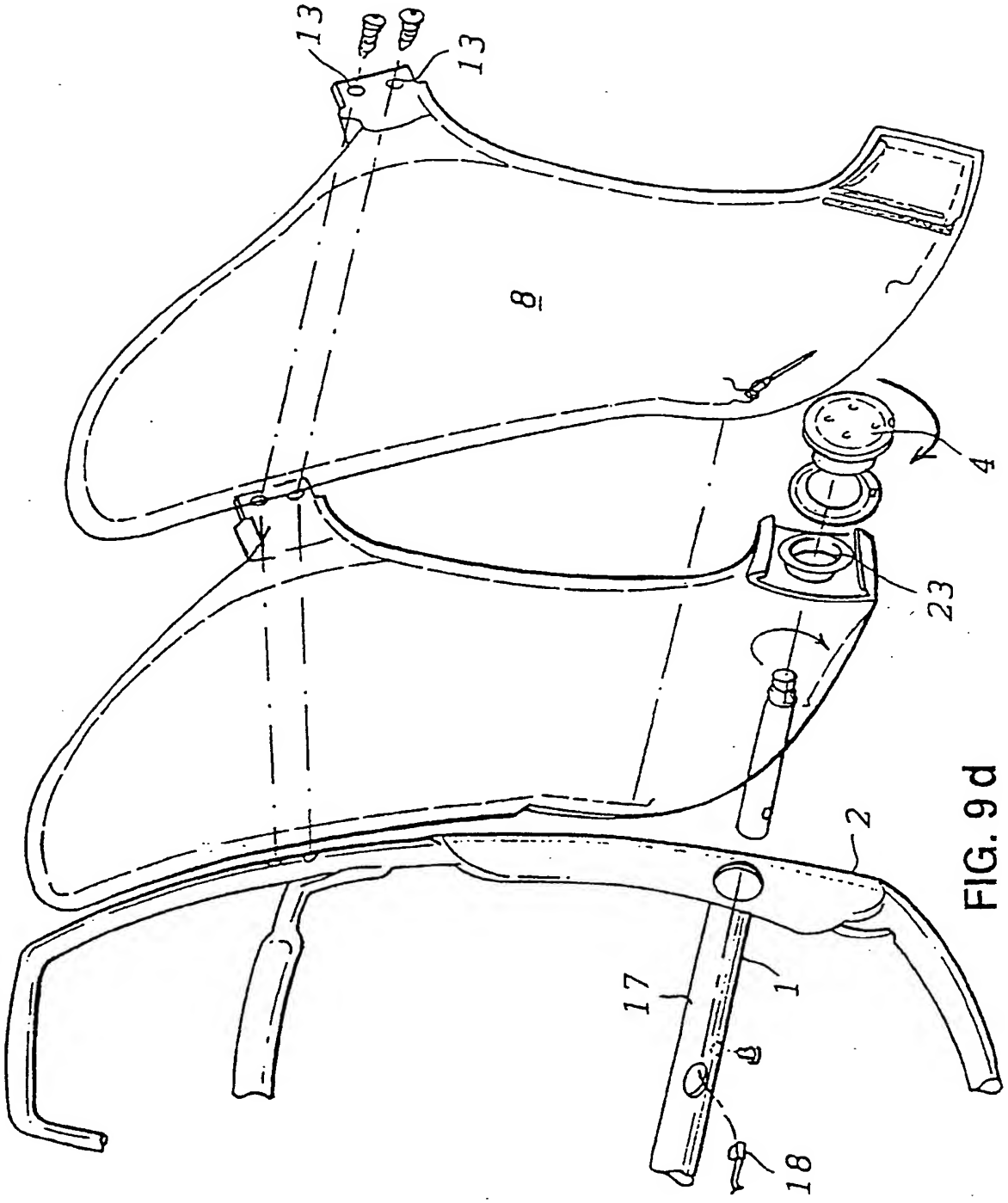

FIG. 9d

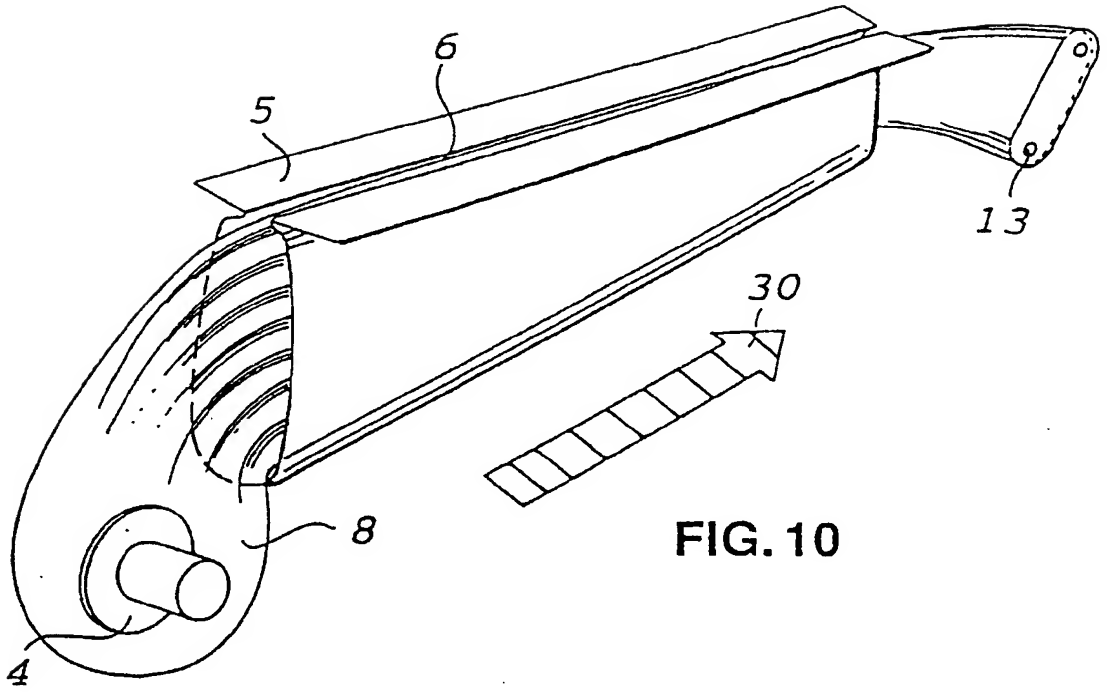

FIG. 10

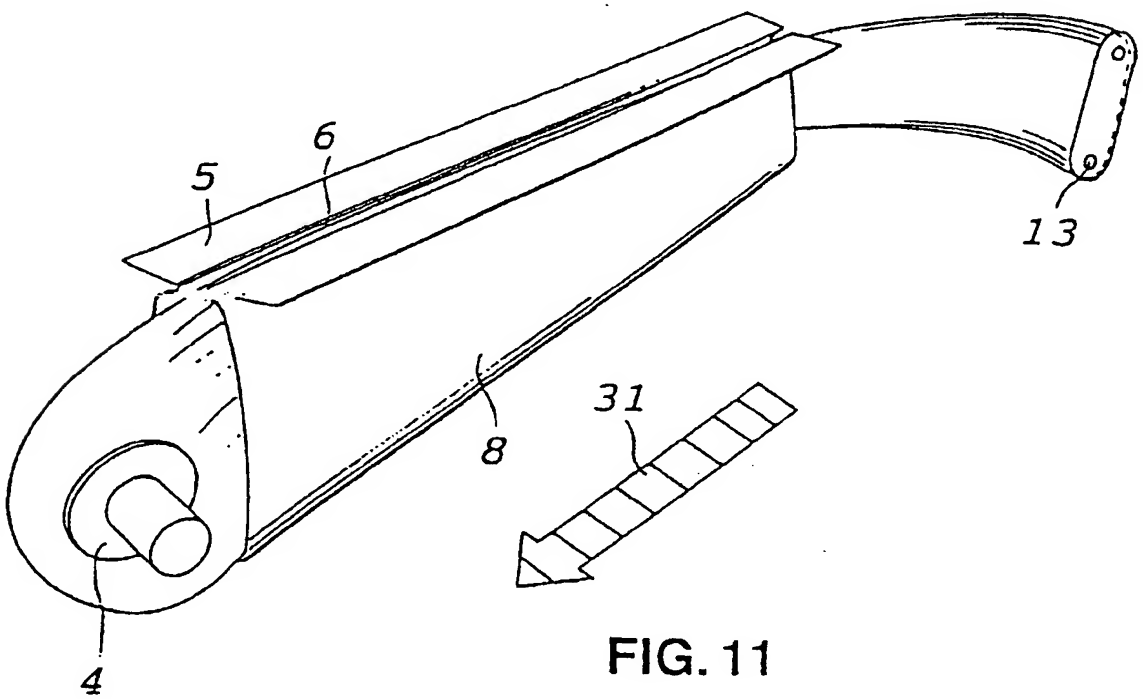

FIG. 11

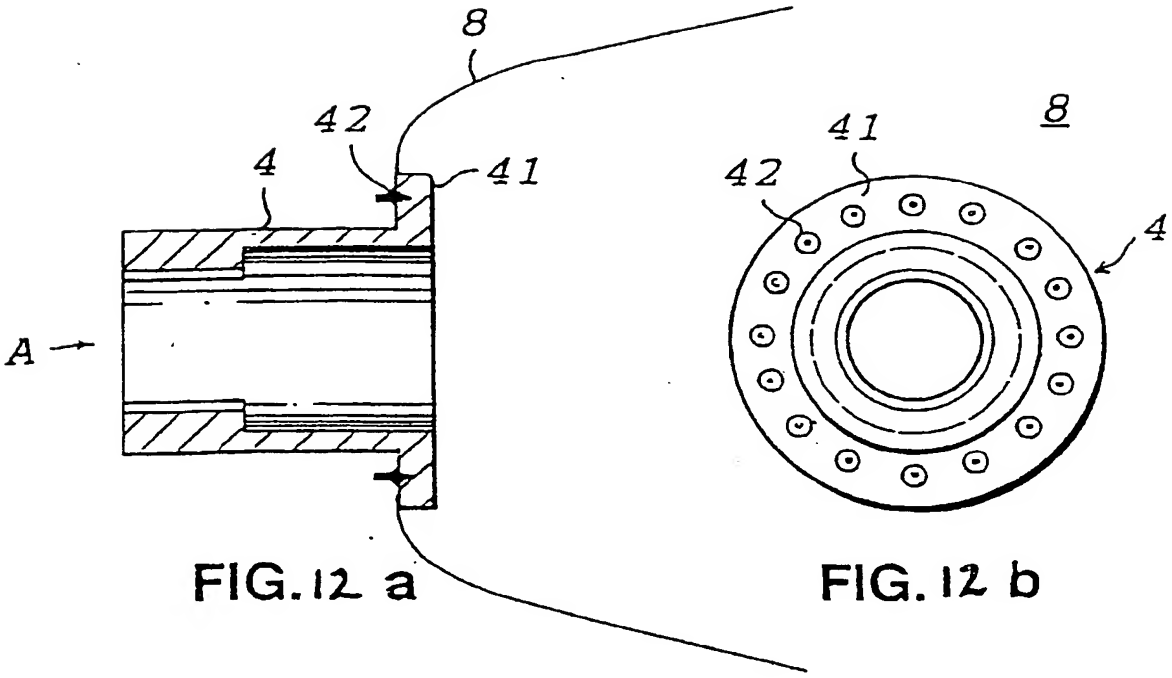

FIG. 12 a

FIG. 12 b

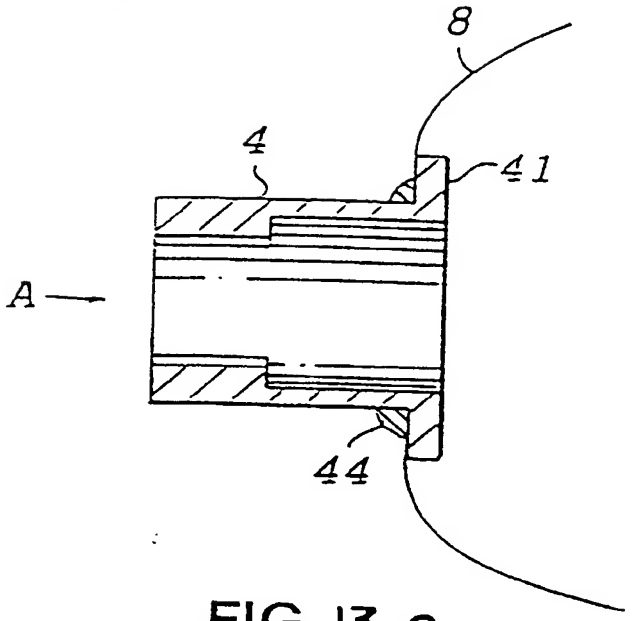

FIG. 13 a

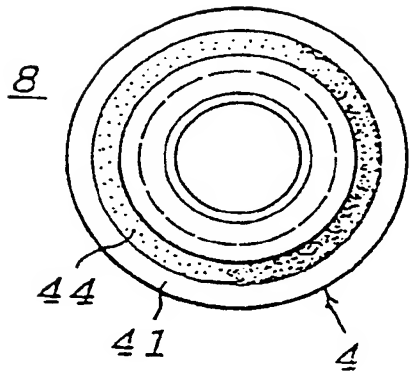

FIG. 13 b

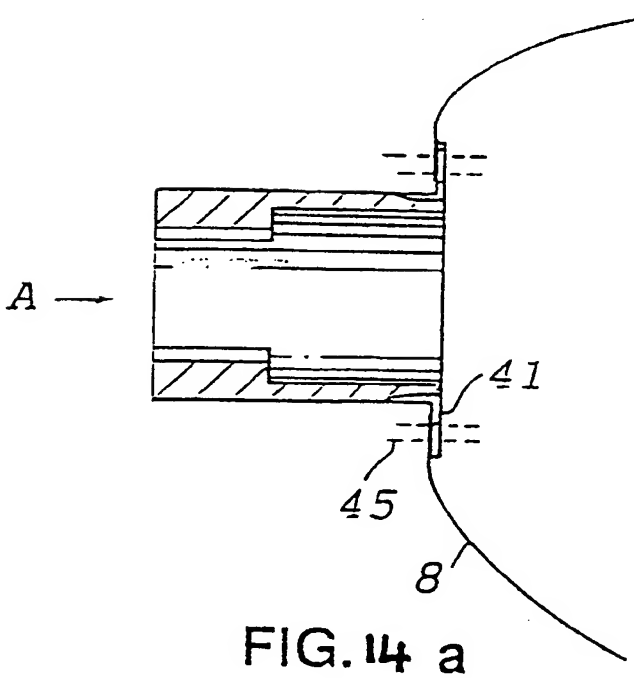

FIG. 14 a

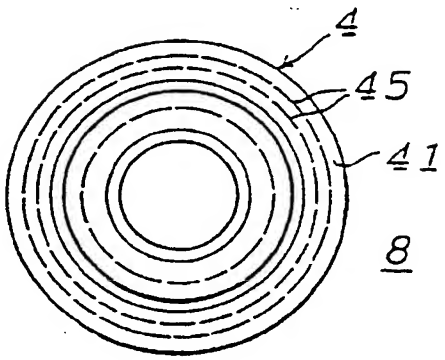

FIG. 14 b

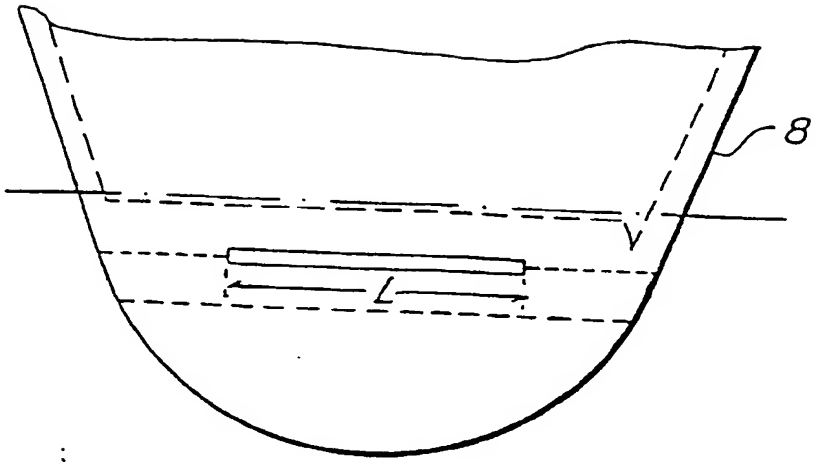

FIG. 15

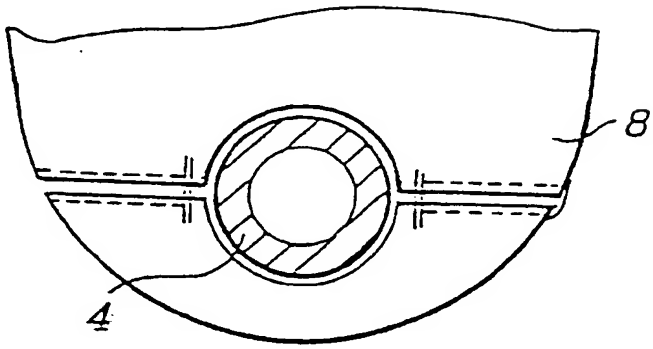

FIG. 16

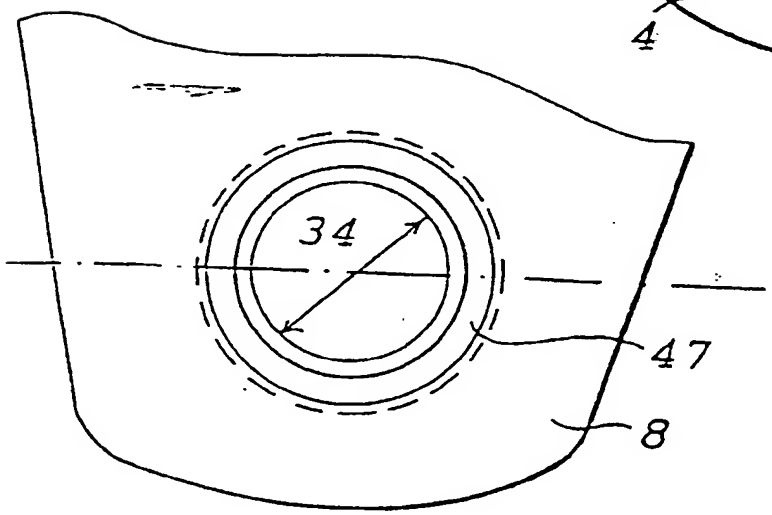

FIG. 17

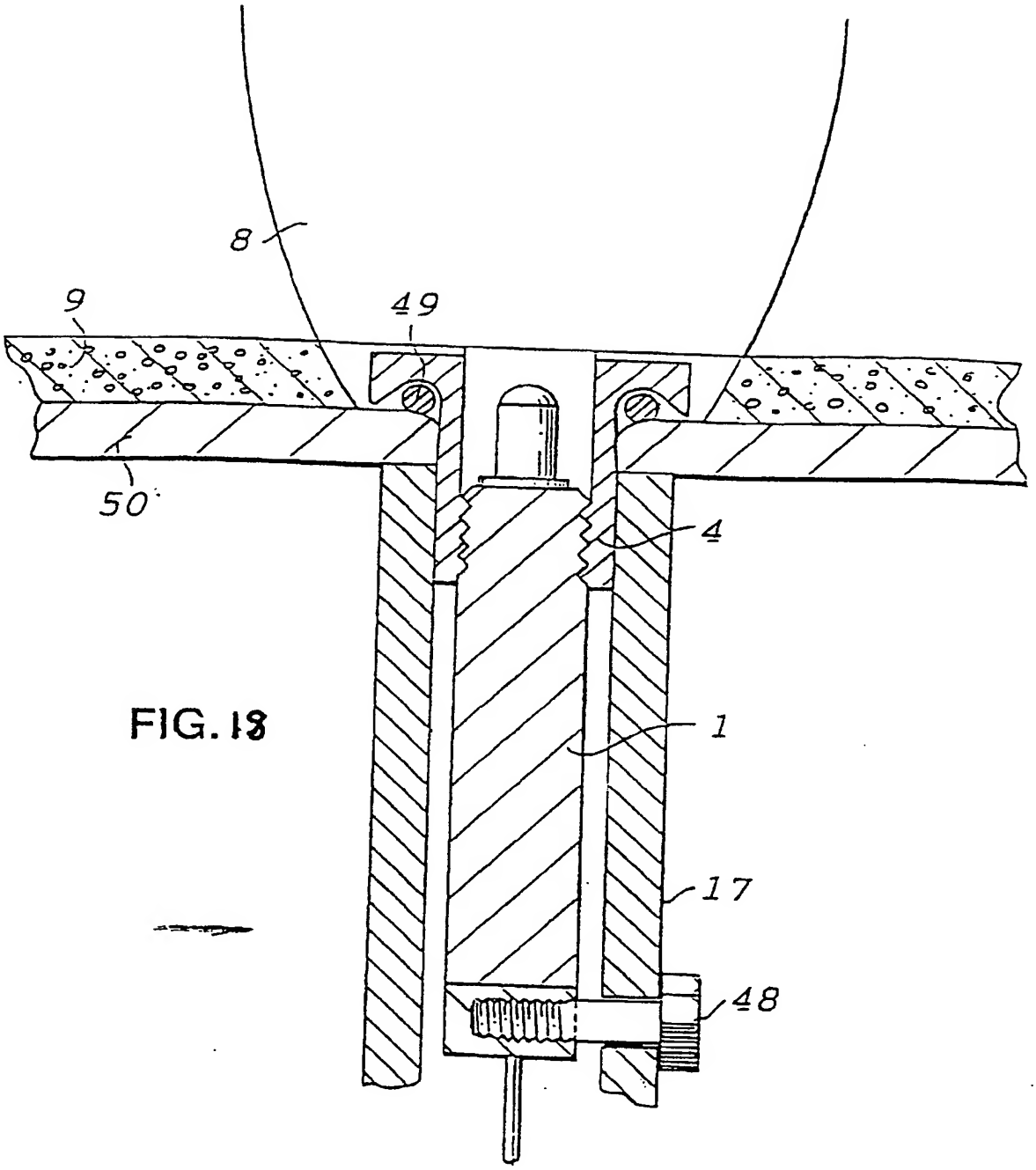

FIG. 18

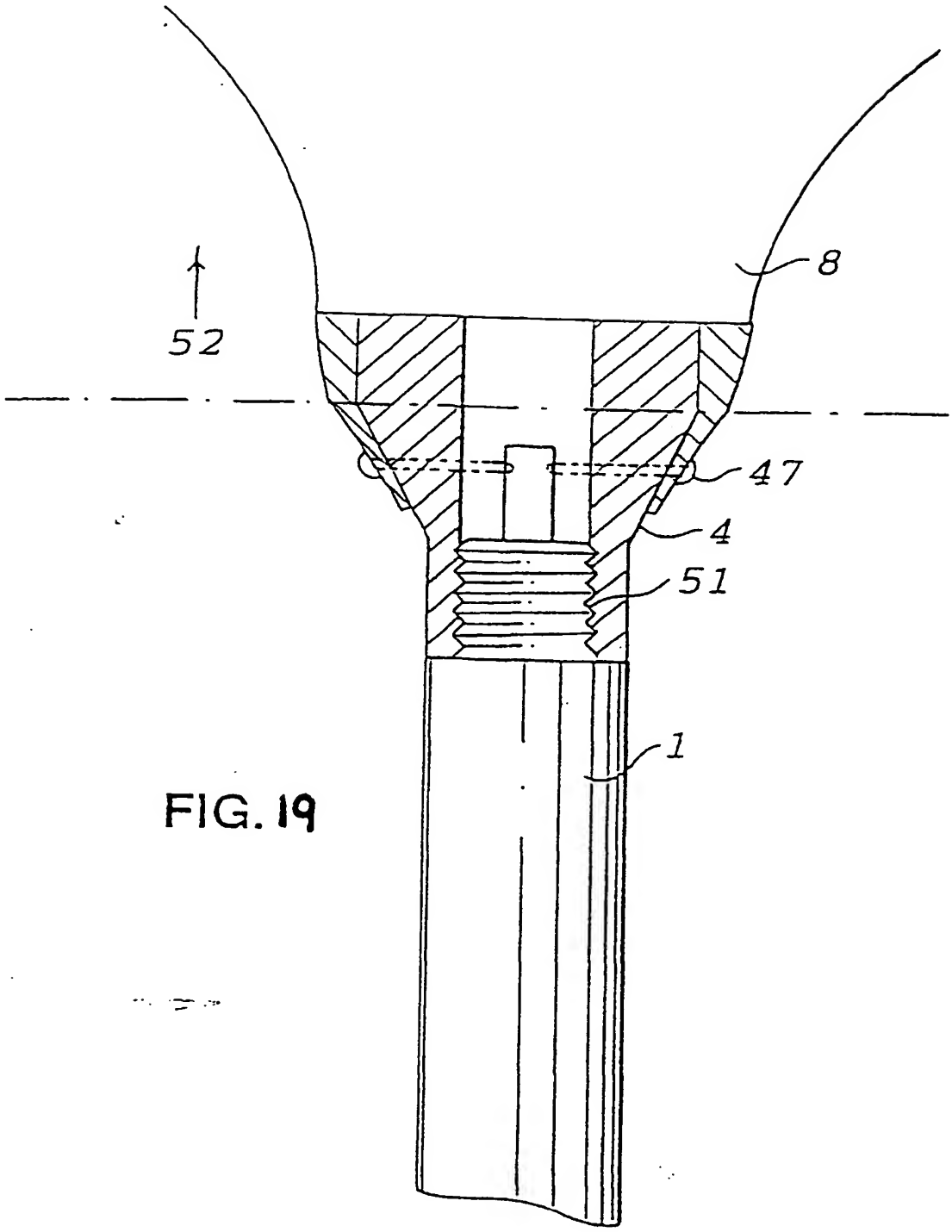

FIG. 19

(19) Europäisches Patentamt
European Patent Office
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(11) EP 1 010 591 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
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(51) Int. Cl.[7]: **B60R 21/16**, B60R 21/20

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21.06.2000 Bulletin 2000/25

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(22) Date of filing: **08.09.1995**

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DE ES FR IT SE

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06.10.1994 GB 9420160

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
95931300.8 / 0 777 591

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(54) Inflatable safety restraint for vehicle occupant protection

(57) An inflatable safety restraint arrangement is provided which is particularly helpful to protect vehicle occupants from transverse components of crash forces such as are experienced in side impacts. An inflatable cushion (8) in the deflated state is folded and mounted in a flexible pocket (5) and is fixedly attached to the vehicle at at least two spaced positions (13,4). The flexible pocket comprises a line of weakness such as a tear (6) seam along which the pocket opens when subjected to forces generated during inflating of the cushion and through which the inflating cushion deploys to a position between the vehicle occupant and the adjacent vehicle surface (eg door) in the event of a crash situation being detected. The flexible pocket is preferably fabric though it may be of a plastics material and the tear seam comprises a stitched seam the stitches of which either break or unravel when the airbag cushion is deployed. The airbag cushion with or without the appropriate inflator may be mounted either in the vehicle seat or in the roof or in a structural side beam such as the B pillar. In the case of mounting the cushion in the seat it is preferably enclosed within the seat cover so as to follow the contours of the seat and provide a comfortable, unobtrusive fitment. In this case the inflator may be advantageously mounted in a main seat tube. Since separate housings are not required either for the inflator or the airbag cushion, considerable savings in expense and assembly time are made.

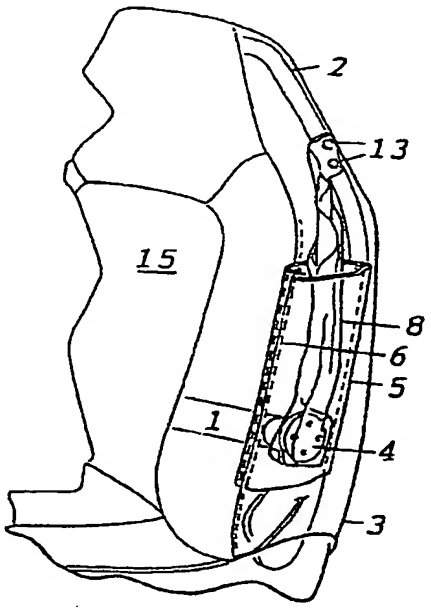

FIG. 1

EP 1 010 591 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 10 3369

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 565 501 A (VOLVO AB) 13 October 1993 (1993-10-13) * page 3, line 9 - line 16; figure 1 *	1	B60R21/16 B60R21/20
A	DE 94 05 143 U (HS TECH & DESIGN) 19 May 1994 (1994-05-19) * page 5, line 18 - line 23; figure 5 *	1	
A	EP 0 611 684 A (PARS PASSIVE RUECKHALTESYSTEME) 24 August 1994 (1994-08-24)		

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B60N
B60R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 November 2000	Marangoni, G

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 10 3369

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21-11-2000

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82